(12) UK Patent Application (19) GB (11) 2 310 006 (13) A

(43) Date of A Publication 13.08.1997

(21) Application No 9524664.1

(22) Date of Filing 01.12.1995

(71) Applicant(s)
Genetix Limited

(Incorporated in the United Kingdom)

Unit 1, 9 Airfield Road, CHRISTCHURCH, Dorset, BH23 3TG, United Kingdom

(72) Inventor(s)
David Elverd

(74) Agent and/or Address for Service
Mark Reid
Genetix Limited, Unit 1, 9 Airfield Road, CHRISTCHURCH, Dorset, BH23 3TG, United Kingdom

(51) INT CL^6
F15B 15/14 13/07

(52) UK CL (Edition O)
F1D DA1 DD DM1 DW D124 D178 D232 D244
F1P P22
U1S S1068 S1289

(56) Documents Cited
GB 0955382 A **GB 0590175 A** **US 4506999 A**

(58) Field of Search
UK CL (Edition O) **F1D DA1 DD DM1 DW DX , F1P**
INT CL^6 **F15B**
ONLINE: WPI

(54) Pneumatic actuator

(57) A Pneumatic Actuator Assembly comprising an array of individual double action pistons contained within a cylinder block (1). Each piston fires and retracts an individual pin by way of differential air pressure which can collect and transfer individual biological samples. Such samples can include prokaryotic or eukaryotic cells or liquid samples.

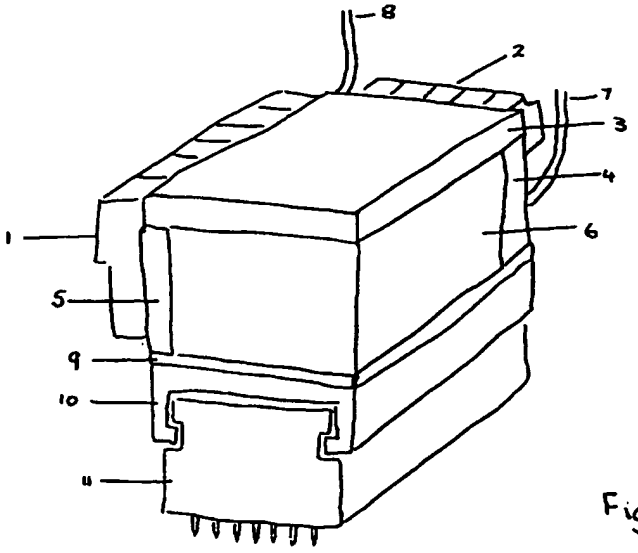

Fig 1

GB 2 310 006 A

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

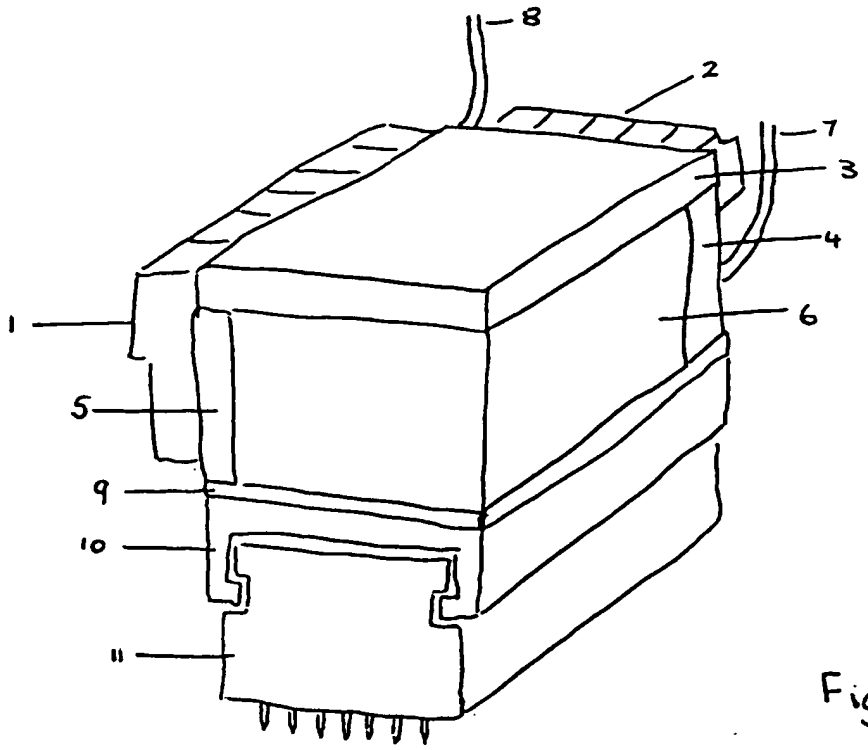

Fig 1

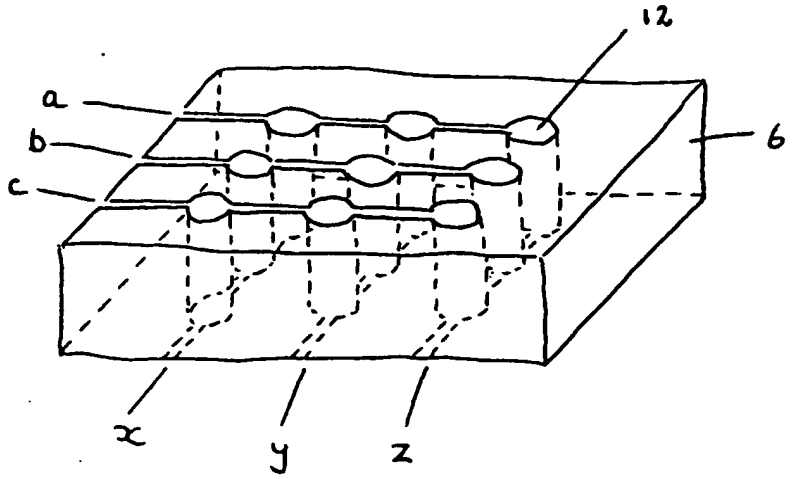

Fig 2

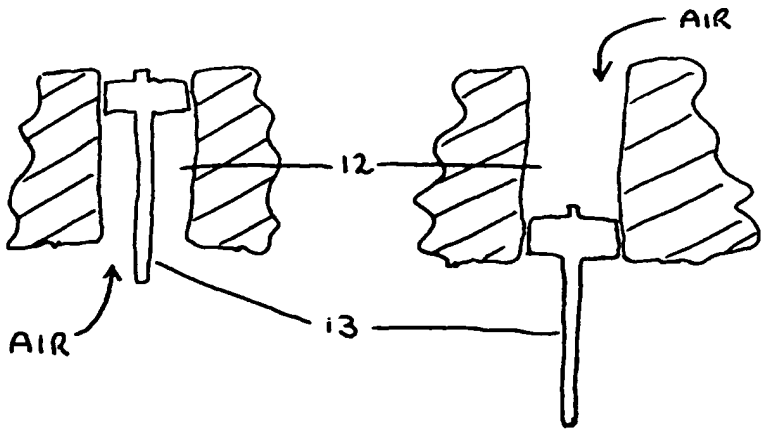

Fig 3a

Fig 3b

PNEUMATIC ACTUATOR

This invention relates to the fields of Molecular Biology and Genetics, in particular to the picking of selected bacterial colonies, from agar culture plates for further study.

In Molecular Biological studies pieces of mammalian DNA (deoxyribonucleic acid, the raw material of genes) are routinely inserted into certain strains of bacteria by a process known as transformation. The mammalian DNA is then integrated into the bacterial DNA and replicated with it.

In order to locate and isolate the inserted DNA of interest the bacteria are cultured on agar plates and each colony is picked and retained for further study.

This procedure has been historically performed by hand using sterile toothpicks which was both time consuming and laborious, (approx. 400 colonies are picked per hour in this manner). More recently, automated robotic colony pickers have been developed which use CCD cameras to visualise and locate the colonies, and either single or multiple steel pins to pick the selected colonies.

However, the single pin design is still relatively slow (approx. 1000 colonies picked per hour), as the pin has to be sterilised after picking each individual colony to avoid cross contamination.

Multiple (96) pin picking heads were then developed to increase the picking speed. These consisted of a block containing an array of sprung pins, in which individual pins are accessed by a single pneumatic cylinder, which is moved across the picking head by means of a miniature XY drive. This method greatly increased the speed of the procedure to approximately 3000 colonies picked per hour.

This method suffers from the problem that by utilising a single cylinder, it has to be indexed over each pin position, with the inherent time delay. This delay becomes even more pronounced if the desired firing order of the pins is random rather than sequential, due to the greater distances that the single cylinder has to be moved. Furthermore, this method can suffer from problems of mechanical reliability.

The present invention relates to a pneumatic actuator assembly, which utilises an array of individual double action pistons contained within a cylinder block. Through the use of differential air pressure any piston within the array can be individually fired, and then positively returned.

Using this invention with a 96 pin picking head, as shown diagramatically in figure 1, it is not only possible to increase the speed of picking colonies to over 5,000 colonies per hour, but also the order of firing the pins can be carried out in a random manner. Also, due to the fact, that the array of individual double action pistons is dimensionally similar to the array of the sprung pins in the picking head, there are no moving parts other than the pistons themselves, therefore improving the mechanical reliability of the device.

The invention will now be described by way of examples and with reference to the accompanying drawings, in which:-

Figure 1 shows schematically an assembly of a 96 pin pneumatic actuator and 96 pin picking head.

Figure 2 shows by way of example a cylinder block with a three by three array (each cylinder bore contains a piston - not shown). Each airway has a dedicated valve controlling the air pressure (the valves are not shown on the drawing). The supply of air to upper and lower airways differs in that the pressure of air feeding the upper airways is always less than that feeding the lower airways.

Referring to the drawings, figure 1 shows a typical example of the construction of a 96 pin actuator and picking head.

The pneumatic actuator consists of a cylinder block 6 which has an array of 96 cylinder bores, laid out in a eight by twelve array. The cylinder bores are joined by a matrix of airways running across the top, similar to a,b and c in figure 2, and the bottom, similar to x,y and z in figure 2, of the cylinder block.

These airways are served with pressurised air by two manifolds 4 and 5, which are controlled by two banks of valves 1 and 2. The air supply to the valves is provided by two airlines 7 and 8, and then via airways within the manifold 4 and 5 to the various valves.

Within each cylinder bore is located a piston 13 whose movement is guided by and array of holes in the location plate 10. Air seals are also located in the location plate 10, which are retained in place by the air seal retention plate 9.

The 96 pin head picking head 11 is aligned under the various pistons, by sliding it into the location plate 10 as shown.

Thus, whenever a piston in the pneumatic actuator is fired it hits a sprung pin in the 96 pin picking head, which is the fired forwards, enabling it to pick a colony.

The mode of action of the actuator will now be described with reference to figure 2, which shows a simplified cylinder block 6 with a three by three array of cylinder bores 12.

The movement of each piston is controlled by air flowing along a matrix of airways, one set on the upper side of the cylinder block 12 (a,b,c), and the other set on the lower side (x,y,z). It is also essential that the pressurised air supply feeding the airways on the lower side (x,y, and z) is always greater than that feeding the top (a,b, and c).

Each piston can identified by a unique set of co-ordinates referring to the corresponding upper and lower airways. For example the central piston has the co-ordinates (b,y).

In the resting state the lower airways (x,y, and z), are maintained at a positive pressure. The upper airways (a,b, and c) are maintained at atmospheric pressure. Therefore the pistons remain retracted (See figure 3a).

To actuate a particular piston (e.g. piston b,y), the valve controlling lower airway (y) is switched, closing off the high pressure air supply and venting it to the atmosphere.

To complete the movement, the valve controlling the corresponding upper airway (b) is switched, opening it to a reduced high pressure air supply. This results in a pressure differential, (high pressure above, low pressure below), and the piston (b,y) is fired downwards (See figure 3b)

No other piston along this upper airway (b) is fired, as the air pressure in the lower airways (x and z) is still greater than that in the upper airway.

To retract piston (b,y) the valve controlling the upper airway (b) is switched, closing off the pressurised air supply and venting it to the atmosphere.

The lower airway valve is then also switched allowing pressurised air to re-enter lower airway (y) This results in a reversed pressure differential in the piston cylinder (high pressure below, low pressure above), returning the piston to the top of the cylinder block 6.

This cycle is then repeated to actuate the next piston.

In this manner it is possible to actuate each piston sequentially or actuate an individual piston at will.

In the examples above we have referred to a three by three array and a eight by twelve array. However, these arrays have been mentioned only by way of example as it is possible, using this invention, to control the movement of pistons within a multitude of differing arrays.

CLAIMS

1. A Pneumatic Actuator Assembly Unit which uses differential air pressure to fire and retract individual or multiple pins.

2. An actuator Assembly Unit as claimed in Claim 1 which fires and retracts 96 pins.

3. An Actuator Assembly Unit as claimed in Claim 1 which fires and retracts 384 pins.

4. An Actuator Assembly Unit as herein described and illustrated in the accompanying drawings.